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2 Circular No. 629

January 1942 • Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE



## Soybean and Korean Lespedeza Hays Compared with Alfalfa for Wintering Beef Calves

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### INTRODUCTION

In recent years a decreased acreage of grain crops on farms in the Middle West, followed by a proportionate increase in the amount of land devoted to forage crops, particularly legumes, has tended to heighten the demand for knowledge about the value of the latter in livestock feeding.

Soybeans have been definitely established in the crop rotation on many farms, and Korean lespedeza, although a legume relatively new to the Corn Belt area, gives promise of becoming a crop of considerable importance. In view of this trend, it was deemed advisable to determine experimentally how these crops, harvested as hay, compare with alfalfa for wintering beef calves. Accordingly, such experiments were conducted cooperatively at Sni-A-Bar Farms, Grain Valley, Mo., by the United States Department of Agriculture and the University of Missouri. In these experiments beef calves, immediately after being weaned in the fall, were fed the three hays in addition to a limited quantity of concentrate mixture and silage. The results are reported in this circular.

### EXPERIMENTAL PROCEDURE

#### CATTLE USED AND METHODS OF FEEDING AND HANDLING

High-grade Shorthorn steer calves dropped in the preceding spring were used in a preliminary feeding trial, carried on in 1933-34, and in two experiments, carried on in 1934-36. The animals were weaned

at approximately 5½ to 6 months of age each year and divided into three groups of about the same average age, weight, and grade and having practically the same number of calves.

The animals were placed in dry lot and fed twice daily such quantities of concentrates as would constitute one-half to three-fourths of full feed. The concentrates consisted of 12 parts, by weight, of shelled corn and 1 part of cottonseed cake. The animals regularly ate this mixture within 10 to 15 minutes after it was fed. A limited quantity of silage was fed on the grain in midwinter each year. In each experiment all three groups of calves received the same quantities of concentrates and silage.

The hay was fed after the concentrates and in sufficient quantities so that the animals were not compelled to eat all the coarse stemmy portion. Some hay usually remained several hours after it was fed. Refused hay, together with foreign material in the baled hay, was weighed each day and the weight subsequently deducted from that of the total quantity fed. Salt and water were available at all times.

A shed with the open side facing south afforded each group of calves a space 20 by 36 feet in size for shelter, and an adjoining lot 36 by 40 feet provided space for exercise. The lots were graded and surfaced with crushed rock. All the feeding equipment was under shelter. Throughout the winter the shed was kept bedded with dry straw.

Records were kept of the individual weights of the calves and quantities of feed consumed by 28-day periods. The average initial and final weights of the animals, as recorded, consisted of an average of the weights taken in the morning after the calves had finished eating, on three consecutive days.

All groups of calves were appraised at the beginning and at the end of the feeding experiment. Commission merchants valued them on the basis of what they would bring on the Kansas City, Mo., market.

### FEEDS USED

The shelled corn fed was No. 2 yellow, uniform in quality. The cottonseed cake contained 43 percent of protein and was of "Screening" grade, the size of the particles being between those in meal and pea-sized cake. The silage was made principally from Atlas sorgo, but some straw was blown in at the time of filling the silo to absorb the excess of moisture in the sorgo.

During the time that these experiments were being carried on attempts to obtain identical grades of the three kinds of hay were unsuccessful, but the hays used were considered typical of the region. Baled hays were used exclusively. They were graded by a representative, from Kansas City, Mo., of the Agricultural Marketing Service, United States Department of Agriculture.

In the 1934-35 experiment, most of the alfalfa fed had been grown in the State of Washington and was of U. S. No. 1 grade, but during the last 28 days of the test locally grown No. 2 Alfalfa Light Grass Mixed was fed. The soybean hay, purchased in Iowa, was graded as border-line U. S. No. 1 and U. S. No. 2, for it was slightly deficient in color and leafiness. The Korean lespedeza hay was grown in Tennessee and was graded U. S. No. 1.

In the 1935-36 experiment the alfalfa hay fed had been grown in Nebraska and was graded U. S. No. 1. Approximately three-fourths of the soybean hay was U. S. No. 1, but nearly one-fourth was designated Sample grade because it appeared to be musty. The Korean lespedeza had been grown locally but was somewhat wiry. It contained more than 10 percent of grass and was therefore graded U. S. No. 2 Lespedeza Light Grass Mixed. Furthermore, it appeared to have been harvested at a stage slightly nearer to maturity than is preferred for the best grade of hay.

Although the hays fed in these experiments were not from pure stands, they were typical of a very considerable portion of those available for cattle feeding, especially in the southwestern part of the Corn Belt.

The prices of the feeds used during these experiments are shown in table 1.

TABLE 1.—*Prices of feeds used in the experiments*

Feed	1934-35	1935-36
Corn.....per bushel	\$0.98	\$0.70
Cottonseed cake.....per ton	38.00	39.00
Alfalfa hay.....do	22.00	12.00
Soybean hay.....do	20.00	10.00
Korean lespedeza.....do	20.00	10.00
Sorgo silage.....do	6.00	4.50

## WEATHER CONDITIONS DURING THE EXPERIMENTS

Table 2 shows average monthly maximum and minimum temperatures and precipitation at Kansas City, Mo.—about 24 miles west of Grain Valley—obtained by the United States Department of Agriculture Weather Bureau. This was the nearest official weather station to the location of the experiment.

The winter of 1934-35 was rather mild and accordingly was favorable for wintering cattle. The winter of 1935-36 was somewhat more severe, especially from the latter part of January through most of February, during which there were experienced some of the coldest periods on record in Missouri. After the first part of March, however, the weather was exceptionally mild each year.

TABLE 2.—*Average monthly temperatures and precipitation during the experiments as recorded at the weather station at Kansas City, Mo.*

Month	1934-35			1935-36		
	Mean temperature		Precipitation	Mean temperature		Precipitation
	Maximum °F.	Minimum °F.	Inches	Maximum °F.	Minimum °F.	Inches
November.....	57.0	38.9	5.40	48.6	34.4	3.84
December.....	38.1	24.1	.53	39.8	24.6	.25
January.....	40.8	24.0	1.13	29.5	13.9	1.17
February.....	44.3	29.3	1.34	29.0	10.3	.55
March.....	61.5	40.8	.69	61.7	36.1	.08
April.....	61.8	42.6	2.30	66.5	42.1	1.89
May.....	67.9	51.7	9.99	81.3	60.5	4.16



## EXPERIMENTAL RESULTS

In a preliminary trial during the winter of 1933-34, the calves fed soybean hay ate a little more hay per pound of their initial live weight and gained at a slightly higher rate than those fed alfalfa, whereas those fed lespedeza hay ate somewhat less hay than those fed alfalfa and gained at a somewhat slower rate. It is believed that the advantage of the calves fed soybean hay over those fed alfalfa and those fed Korean lespedeza, with respect both to rate of gain and appearance at the end of the trial, was due principally to the large percentage of mature beans in the soybean hay. Nevertheless, all three groups of calves made satisfactory winter gains and were in good condition when the feeding trial ended April 4, 1934.

## EXPERIMENT 1 (1934-35)

The first experiment began on November 21, 1934, when 33 calves were taken from their dams on pasture and brought to the feed lot, weighed and divided into 3 uniform groups. The average ration, that is, the average daily feed consumed per calf, and the results obtained are shown in tables 3 and 4.

In this experiment the group 1 calves consumed 2.73 pounds of hay, group 2 calves 2.64 pounds, and group 3 calves 2.67 pounds, for each pound of their respective initial live weights. During the entire 140 days of feeding the calves in group 2 ate only 3.6 percent less hay than the group 1 calves but made 10 percent less gain, and the calves in group 3 ate only 2.2 percent less hay yet made 10.9 percent less gain. Thus both groups 2 and 3 were somewhat less efficient in utilizing their feed than group 1. The fact that the cost per head for hay was highest in the case of the group receiving alfalfa is due principally to the higher cost per ton for this hay than for the other kinds of hay fed.

TABLE 3.—Average rations and daily gains per calf by 28-day periods in experiment 1, 1934-35

Group No.	Kinds of feed and gain	Quantity consumed in period indicated and average daily gain					Average
		First	Second	Third	Fourth	Fifth	
		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
1	Corn and cottonseed-meal mixture..	1.85	3.38	4.74	5.25	6.79	4.40
	Alfalfa hay.....	4.74	6.93	7.24	7.44	8.78	7.03
	Sorgo silage.....			2.45	3.25		12.85
	Average daily gain.....	1.04	1.03	2.38	1.16	2.27	1.58
2	Corn and cottonseed-meal mixture..	1.85	3.38	4.74	5.25	6.79	4.40
	Soybean hay.....	5.41	7.10	6.60	7.16	7.73	6.80
	Sorgo silage.....			2.45	3.25		12.85
	Average daily gain.....	1.09	.78	2.31	1.19	1.76	1.42
3	Corn and cottonseed-meal mixture..	1.85	3.38	4.74	5.25	6.79	4.40
	Lespedeza hay.....	4.28	7.03	7.29	7.36	8.39	6.87
	Sorgo silage.....			2.45	3.25		12.85
	Average daily gain.....	1.18	.78	1.99	.97	2.09	1.41

<sup>1</sup> The average quantities of silage shown are based on actual days fed—58 days, Jan. 17-Mar. 16, 1935.

The slightly lower condition of the group 2 than of the group 1 calves at the end of the experiment may have been due to the lower quality of the soybean than of the alfalfa hay. For a short time

the group 3 calves displayed a tendency to pull the hay out of the feed rack and trample it into the bedding, making it impossible to weigh back all the hay not eaten. Nevertheless, the group 3 calves equaled those in group 1 in condition and were valued the same as group 1. The group 2 calves were valued a little lower than the other groups because of their slightly lower condition.

TABLE 4.—*Comparison of average results for steers fed alfalfa, soybean, and Korean lespedeza hays during 140 days of experiment 1, from November 21, 1934, to April 10, 1935*

Item	Group 1, fed alfalfa hay <sup>1</sup>	Group 2, fed soybean hay <sup>1</sup>	Group 3, fed Korean lespedeza hay <sup>1</sup>
Calves in group.....number.....	11	11	11
Initial weight per calf.....pounds.....	360	360	360
Final weight per calf.....do.....	581	559	557
Gain per calf.....do.....	221	199	197
Hay consumed per calf.....do.....	984	949	962
Value of total quantity of hay consumed per calf.....dollars.....	10.82	9.49	9.62
Gain per 100 pounds of hay consumed.....pounds.....	22.4	20.9	20.4
Appraised value per 100 pounds of live weight of calves.....dollars.....	8.00	7.90	8.00

<sup>1</sup> The calves were fed a mixture of shelled corn and cottonseed meal, and a small quantity of silage was added during a portion of the winter.

## EXPERIMENT 2 (1935-36)

On December 6, 1935, 28 calves were weighed, divided as uniformly as possible into groups, and placed on test. These calves not only weighed less but were thinner than those used in the preceding experiment. For this reason it was decided to feed the concentrates at a somewhat higher rate per head daily, but the quantity was the same for all groups (table 5). As in the previous year's experiment, the hay fed to groups 1, 2, and 3, respectively, consisted of alfalfa, soybean, and Korean lespedeza. The results of the 1935-36 experiment are shown in table 6.

During the 140 days of feeding, group 1 calves ate 4 pounds of hay, group 2 calves, 2.84 pounds, and group 3 calves, 3.61 pounds, for each pound of their average initial live weights.

The gains of the three groups of calves were substantially greater than those in experiment 1 because, as stated above, the calves were fed on a higher plane of nutrition. However, in 1935-36, although the group 2 calves ate 27.5 percent less hay, their gain was only 17.1 percent less than that of group 1, whereas group 3 ate 10.5 percent less hay and made 13.7 percent less gain than group 1. Thus, the group fed soybean hay utilized this feed somewhat more efficiently than the group fed alfalfa hay, but the calves fed lespedeza hay were a little less efficient than those in group 1 in this respect.

The value of the hay consumed by the group 2 and group 3 calves was \$3.02 and \$1.94 less per head, respectively, than that of the hay consumed by group 1. However, as shown in table 1, alfalfa hay was valued at \$2 more a ton than the other hays.

At the end of the experiment the condition of the calves in groups 2 and 3 was somewhat lower than that of group 1, and for this reason both groups were classed as feeders and valued at \$0.25 less per 100 pounds of live weight than the calves in group 1, which were fat enough to be classed as slaughter animals.

TABLE 5.—Average rations and daily gains per calf by 28-day periods in experiment 2, 1935-36

Group No.	Kinds of feed and gain	Quantity consumed in period indicated and average daily gain					Average
		First	Second	Third	Fourth	Fifth	
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1	Corn and cottonseed-meal mixture.....	4.50	6.00	6.27	6.75	8.54	6.41
	Alfalfa hay.....	6.14	7.47	9.35	9.66	12.80	9.08
	Sorgo silage.....		2.75	3.00	3.00	1.62	12.59
	Average daily gain.....	1.85	2.56	2.10	2.16	2.82	2.30
	Corn and cottonseed-meal mixture.....	4.50	6.00	6.27	6.75	8.54	6.41
2	Soybean hay.....	5.56	6.30	6.51	6.60	7.94	6.58
	Sorgo silage.....		2.75	3.00	3.00	1.62	12.59
	Average daily gain.....	1.65	1.54	2.19	2.04	2.12	1.91
	Corn and cottonseed-meal mixture.....	4.50	6.00	6.27	6.75	8.54	6.41
	Lespedeza hay.....	5.76	6.00	9.09	9.22	10.57	8.13
3	Sorgo silage.....		2.75	3.00	3.00	1.62	12.59
	Average daily gain.....	2.23	1.71	1.84	1.81	2.34	1.90

<sup>1</sup> The average quantities of silage shown are based on actual days fed—101 days, Jan. 2 to Apr. 12, 1936.

TABLE 6.—Comparison of average results for steers fed alfalfa, soybean, and Korean lespedeza hays during 140 days of experiment 2, from December 6, 1935, to April 24, 1936

Item	Group 1, fed alfalfa hay <sup>1</sup>	Group 2, fed soybean hay <sup>1</sup>	Group 3, fed Korean lespedeza hay <sup>1</sup>
Calves in group.....number.....	10	9	9
Initial weight per calf.....pounds.....	318	325	315
Final weight per calf.....do.....	640	592	593
Gain per calf.....do.....	322	267	278
Hay consumed per calf.....do.....	1,272	922	1,138
Value of total quantity of hay consumed per calf.....dollars.....	7.63	4.61	5.69
Gain per 100 pounds of hay consumed.....pounds.....	25.3	29.0	24.4
Appraised value per 100 pounds of live weight of calves dollars.....	8.00	7.75	7.75

<sup>1</sup> The calves were fed a mixture of shelled corn and cottonseed meal, and a small quantity of silage was added during a portion of the winter.

The results obtained with the group 3 calves reflect the value of the Korean lespedeza hay used in this experiment for wintering calves. However, as stated earlier, it contained more than 10 percent of grass and appeared to have been harvested at a stage slightly nearer to maturity than is preferred for the best grade of hay. Consequently, results might be somewhat different in experiments involving U. S. No. 1 grade of lespedeza.

## SUMMARY AND CONCLUSIONS

Three groups of high-grade Shorthorn steer calves 5½ to 6 months of age when weaned were used in experiments to compare soybean and Korean lespedeza hays with alfalfa as dry roughages in wintering rations. The animals were fed for 140 days at Sni-A-Bar Farms, Grain Valley, Mo., in 1934-35 and 1935-36.

A mixture of shelled yellow corn and cottonseed meal (12 parts to 1 part, by weight) and sorgo silage were fed twice daily in limited quantities, but these were the same for all groups. The quantity of concentrate mixture fed represented from one-half to three-fourths of a full-feeding rate. The calves in each group received a different kind



of hay but in such quantities that they were not forced to eat all the coarse stemmy portions. Refused feed was weighed, removed from the feed lots, and the quantity deducted from the weight of that fed in order to determine the daily feed consumption.

A shed with a southerly exposure afforded shelter for the calves, and a lot, graded and surfaced with crushed rock, provided space for them to exercise.

In the winter of 1934-35 calves fed soybean hay ate 3.6 percent less hay than the calves fed alfalfa but made 10 percent less gain. The calves fed Korean lespedeza hay ate only 2.2 percent less hay yet made 10.9 percent less gain. Thus the soybean and lespedeza hays were somewhat less efficient than the alfalfa hay in wintering the calves.

In the winter of 1935-36 the calves at the beginning of the experiment were lighter and thinner than those in the 1934-35 experiment and for this reason were fed on a somewhat higher plane of nutrition. Their gains were substantially higher than the gains of the calves in 1934-35.

In the 1935-36 experiment the calves fed soybean hay ate 27.5 percent less hay but their gain was only 17.1 percent less than that of the animals fed alfalfa, whereas the calves fed Korean lespedeza hay ate 10.5 percent less hay and made 13.7 percent less gain than those fed alfalfa. Although the group of calves fed soybean hay made less gain than those fed alfalfa, the soybean hay produced somewhat more efficient gains than did the alfalfa. The calves fed lespedeza likewise gained less than those fed alfalfa, and the lespedeza was not quite so efficient as the alfalfa in wintering the calves.

Although the grades of the three kinds of hays varied somewhat and the rate of gain and the quantity of roughage consumed by the calves were slightly different, in general all three kinds of hays gave satisfactory results when used as dry roughages in beef-calf wintering rations.

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